The Tiger Beetles of Kansas

(Family Carabidae; subfamily Cicindelinae)

Order Coleoptera

A Thesis presented to the Department of Entomology and to the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the Degree of Master of ~~Arts~~ Science, May 15, 1918.

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INTRODUCTION

The purpose of this paper has been to prepare a treatise on the Cicindelinae of Kansas, treating of the systematic, biologic and ecologic phases of this group. The writer first became interesting in Cicindelinae on his trip with the Kansas University Biological Survey party during the summer of 1917. The results of field observations and laboratory work are given in this paper.

Tiger beetles are among the most interesting and beautiful of the order Coleoptera, fierce blood-thirsty creatures, rushing here and there in search of prey. The name Cicindela itself is of Latin origin, derived from the word meaning Candela, the "bright and shining one." The Anglo-Saxon cognomen "tiger beetle" gives an indication of their true nature, most of the species being highly predatory. The species are brightly and often beautifully colored. Our North American forms are ground dwellers and are usually found in the open. Certain of the tropical species lurk on the leaves of tropical plants and similar situations, waiting for their prey. (Can. Ent. 12, No. 4, pp. 61-67).

Dr. Walther Horn's grouping of the tribes and genera, as well as the names given to the different species, have been followed. The key is, in part, modeled after Mr. Schaupp's key in the Bulletin of the Brooklyn Entomological Society (vols. 4-7). The internal anatomy of the larva of C. 12-guttata, var. repanda, and

the external anatomy of the larva and adult of the same species are considered. Drawings are, in nearly every case, original.

In conclusion, the writer wishes to thank Messrs. Leng and Knaus for the determination or confirmation of certain species; Mr. C. P. Alexander, Assistant Curator of the Snow Collections, for his many helpful suggestions throughout the work; Mr. P. B. Lawson for his aid in working out the morphology and constructing the key; Professor H. B. Hungerford for his assistance in working up the literature; Mrs. C. P. Alexander for the typing of the manuscript; and finally Professor S. J. Hunter, in whose deparment the work was done, for his helpful suggestions and patience in going over the manuscript.

The Cicindelinae of the world are represented by 1299 species and subspecies, representing about 35 genera. (Illinois Biological Monographs, vol. 3, No. 4, pp. 8-9). The groups representing this family are outlined in "Genera Insectorum" as follows:

	No. of Species
Subfamily Ctenostomini (tree dwellers)	
Pogonostoma; Madagascar	32
Ctenostoma	45
Subfamily Collyrini (nearly all tree dwellers)	
Tricondyla; India	27
Collyris; Oriental region	104
Subfamily Mantichorini (ground dwellers)	
Mantica; Africa	1
Mantichora; Africa	5
Subfamily Megacephalini (ground dwellers)	
Platychila; South Africa	1
Pyconchila; South America	1
Amblycheila; Western United States	2
Omus; Western United States	4
Aniaria; Northeastern South America	1
Megacephala; Southern United States to Argentina, Arabia, Persia, Australia	68
Oxychila; Middle America	25
Pseudoxychila; Andes, Costa Rica to Bolivia	1
Chiloxia; Andes of Ecuador to Bolivia	1
Eucallia; Andes of Ecuador and Colombia	1

	No. of Species
Subfamily Cicindelini; ground dwellers	
Dromica; Southern half of Africa	82
Prothyma; Africa, Madagascar, Asia, and the Malay Archipeligo	50
Dilatotarsi; Malay Archipeligo	1
Caledonomorpha; New Guinea	1
Distipsidera; Australia and New Guinea	8
Caledonica; New Guinea	9
Nickerlea; Australia	2
Rhysopleura; Australia	1
Euprosopus; Brazil	2
Langea; Peru	1
Iresia; Continental tropical America	8
Therates; Malay Archipeligo	33
Odontochila; South America, Malay Peninsula and Islands	75
Prepusa; South America	3
Oxygonia; South America	15
Opisthencentrus; Brazil	1
Cicindela; World-wide distribution	686
Eurymorpha; Africa	1
Apteroessa; India	1
	1299

The subspecies of Cicindela numbered in Horn's Genera Insectorm include 55 in all. More than eight subspecies of Megacephala and several other genera are not included.

In the United States proper we generally include four genera, namely, Omus, Megacephala, group Tetracha, Amblycheila, and Cicindela. Of these Omus is found only on the Pacific Slope, ranging in general from Vancouver Island to Monterey County, California. Tetracha is found east of the Rockies to the Atlantic. Amblycheila inhabits western United States, especially western Kansas, Colorado, Oklahoma, New Mexico, eastern Arizona, and Texas. Cicindela is general throughout the United States.

In Kansas we find one species of Amblycheila, namely, cylindriformis. This is our most notable species and will be taken up historically in its relation to Kansas. One species of Tetracha, virginica, ranges generally over the state. Of Cicindela there are 18 species, 3 subspecies, 9 aberrations, and one variety, which will be taken up individually in the key.

SYSTEMATIC TREATISE OF THE SUBFAMILY CICINDELINAE.

The key and descriptions are taken from former workers in this field and modified where necessary to fit the Kansas forms. The writer has drawn especially from the work of Mr. Schaupp, Bulletin of the Brooklyn Entomological Society, volume 6, and Dr. Walther Horn's Genera Insectorum. This last was begun in 1908 with volume 82a, followed by volume 82b in 1910, and the work completed in volume 82c in 1915.

"The entire work of Dr. Horn covers 475 pages and embraces exhaustive treatises on the anatomy and phylogeny of the Cicindelinae as an introduction to the classification of the genera of which the subfamily is composed. This introductory matter is of special interest because of the value ascribed by the author to the pubescence (particularly of the Cicindelidae) as a guide in the classification of that genus. In 1899 (Deutsche Ent. Zeit. p. 34) Dr. Horn had called attention to the parallelism existing between the pubeseence and the elytral markings. In 1906 (Ib., p. 336) he emphasized his theory by suggesting that there had been an evolution from immaculate forms, in which only constant hairs occur, to forms exhibiting complex markings, accompanied by ornamental pubescence as well as constant hairs. In his last work the words (maculation and ornamental pubescence are both products of concurrent evolution" still more establish the author's grounds for his subsequent classification. The maculation being subject to such great degree of variation from climatic and other causes as to become liable to mislead if relied upon in classification, he considers the pubescence, and especially the constant hairs, which to some extent at least escape such variation, the safer guide. The recognition of the constant hairs becomes, therefore, of importance, and pages 210 to 222 of Dr. Horn's work are devoted to them. Usually these are 'long, thin, erect, and few in number," those of the trochanters being of that kind; the ornamental hairs are "short, thick, decumbent, and countless in number", those of the clypeus and pronotum affording examples. The constant hairs are, however, sometimes short and bristle like, as on parts of the legs, and are always to be more readily recognized as being borne on a definite part of the body, and invariably in an erect position." (Cicindelinae of North America as arranged by Dr. Walther Horn in Genera Insectorum; Harris and Legg).

Cicindela itself has been arranged into 16 groups, each distinguished by its peculiar vestiture. This system of grouping has been accepted by all the leading workers in this

subfamily, including Messrs. Leng and Harris, two of the foremost authorities of today. Therefore the writer has adopted this arrangement in part for the Kansas forms mentioned in this paper.

Family CARABIDAE.

Subfamily CICINDELINAE.
Of the Nearctic Retion.

Tribe MEGACEPHALINI.

Subtribe Omina.

Genus Amblycheila Say.

Genus Omus Eschscholtz.

Subtribe Megacephalina.

Genus Megacephala Latreille.

Group Tetracha Hope.

Tribe CICINDELINI.

Subtribe Cincindelina.

Genus Cicindela Linne.

A Key to the Kansas Cicindelinae.

Cicindelinae.

Antennae filiform, 11-jointed, inserted on the front above the base of the mandibles, which are long and sharply toothed; hind coxae mobile and simple; abdomen of female six-segmented, while the last segment of male is broadly notched exposing the seventh segment; first three joints of tarsi dilated and densely pubescent.

Posterior coxae separated; eyes small *Amblycheila*

Posterior coxae contiguous; eyes prominent.

Third joint of maxillary palpi longer than the fourth — Genus *Megacephala* (Group *Tetracha*)

Third joint of maxillary palpi shorter than the fourth — Genus *Cicindela*

Amblycheila Say.

A. cylindriformis Say.

This is the only species occurring in Kansas. It is found in western Kansas, south of the Smoky Hill river (see page 30).

Megacephala Latreille, Group *Tetracha* Hope.

M. virginica Linn.

This is the only species found in Kansas, occurring throughout the state (see page 34).

Cicindela Linn.

Key to the Divisions of the Genus.

A1. Humeral angles wanting. Division One (p. 10).

A2. Humeral angles distinct, winged species. Underside metallic green or blue, sometimes black; hind trochanter of the same color. Division Two (p. 10).

A3. Humeral angles distinct; underside unicolorous; hind trochanter rufous. Division Three (p. 14).

Key to the Species in the Divisions.

A1 Division One.

Group One.

Humeral angles wanting.

With aborted wings, sericeous brown with imperfect white markings. celeripes Lec.

Wingless, black with green punctures. belfragei Salle.

A2 Division Two.

Humeral angles distinct, winged species. Underside metallic green or blue, sometimes black, hind trochanters of the same colors; elytra of the male and female of the same shape.

Key to the groups in Division Two.

Front glabrous.

Thorax flattened. Group 1. (p. 11).

Thorax cylindrical. Group 5. (p. 14).

Front hairy (except 6-guttata, group 2).

Thorax narrowed behind. Group 2 (p.

Thorax not narrowed behind.

Elytra rounded at the tip. Group 3 (p.

Elytra pointed at the tip and widened distinctly in front of the middle. Group 4 (p.

Key to the Species of Division Two.

Group One.

Thorax flattened, preceptibly margined, trapezoidal, front glabrous; palpi black, elytra flattened, tip serrate. obsoleta Say.

Group Two.

Thorax convex, not margined, narrowed behind; front hairy (except 6-guttata), palpi black; elytra convex.

1. Elytra with marginal markings or unmarked.
   a. Thorax not granulate, hardly rugose, surface not polished; pectus and legs sparsely clothed with white erect hairs, outer side of middle tibiae densely pubescent, head and thorax gree or blue; elytra reddish brassy with green disc, often with humeral, marginal and apical dot. scutellaris Say.
   aa. Thorax smooth; elytra brilliantly red-cupreous with a marginal and sometimes a humeral dot, front hairy. pulchra Say.
2. Elytra with normal markings; the humeral often wanting.
   a. Front striated, glabrous, thorax finely rugose,

strongly impressed; elytra strongly punctured, finely serrulate, green with marginal, anteapical, apical and sometimes a discal dot; body beneath sparsely pilose. 6-guttata Fabr.

Blue green or immaculate.

aber. violacea Fabr.

aa. Front striated, pilose with erect hairs, thorax short somewhat flattened, granulate rugose, deeply impressed; elytra moderately punctured, less so near the margin, which is usually broad green shining, punctures elevated; slightly serrulate at tip; body beneath with long white hairs. Surface reddish cupreous with an oblique scarcely sinuate band, not reaching the outer margin and an apical dot. purpurea Oliv.

Black with the same markings.

aber. audubonii Lec.

Green with the same markings.

aber. graminea Schaupp

Head and thorax green or blue, elytra cupreous with a very short middle band and an apical dot. subsp. splendida Hentz.

Green form of purpurea.

aber. denverensis Casey.

Red form of purpurea. aber. transversa Leng.

Pupple with same dots, and a sinuate middle band. subsp. limbalis (equals amoena)

Group Three.

Thorax convex, not margined, subquadrate; palpi of male usually pale at base; elytra convex and rounded at tip; front hairy.

1. Markings normal and complete, connected by the white margin. Robust large species; labrum moderately large, three-toothed, prominent in the middle.

   a. Red cupreous, brilliant, middle band obtusely bent. formosa Say.

   Metallic brown, same markings.

   aber. generosa Dej.

   aa. Red cupreous, more slender and convex, middle band more perpendicular.

   Lengi W. Horn

   (venusta LeConte equals Lengi)

11. Markings broad not connected at the margin.

   Elytra red cupreous, brilliantly shining.

   fulgida Say.

111. Markings narrower, color usually brown bronze.

   a. Humeral lunule very long and obliquely prolongated middle band but little extended along the margin. tranquebarica Herbst.

   (vulgaris Say equals tranquebarica)

   aa. Humeral lunule lacking but with humeral dot instead, all markings broken, brown.

   12-guttata Dej.

   Brown with normal markings not broken, humeral lunule C-shaped, humeral lunule and middle band connected at the margin.

   subsp. repanda Dej.

Form with partial confluence of markings at margin. aber. unijuncta Casey.

Group Four.

Thorax convex, quadrate, tip of elytra pointed, elytra widens suddenly and distinctly in front of half way back.

Humeral lunule perpendicularly inflexed and bent upwards at tip, thorax very hairy, that of female more flattened; brown or greenish.

hirticollis Say.

Form with uniformly widened markings.

aber. ponderosa Thomson.

Group Five.

Thorax subcylindrical, front bald.

Elytra densely punctured with a row of unusual large green foveae near the suture, humeral lunule and middle band indicated by scattered punctures, apical lunule complete, black, brown or greenish species.

punctulata Oliv.

Green form; head and thorax sometimes bronzed; markings same as punctulata Oliv.

aber. chihuahuae Bates equals micans Fab.

Division Three.

Humeral angles distinct, winged species, underside unicolorous but the hind trochanter rufous, purple or brownish red; eyes large, prominent, legs long.

1. Elytra with basal white spot.

Cupreous; elytra coarsely and densely punctured those of female strongly sinuate near the tip,

tooth acute and prominent, tip rounded; tip of female obtuse. cuprascens Lec.

Bronzed; elytra finely and densely punctured, tooth obtuse, tip slightly prolonged.

subsp. macra Lec.

11. Elytra without basal spot.

a. Markings not or slightly connected at margin, middle band with short, feebly sinuous longitudinal portion. nevadica Lec.

Form with fully developed normal markings.

var. knausii Leng.

aa. Markings broadly connected at the margin, not as above.

b. Elytra broad and flat, with a few sinuous dark lines, legs, antennae and sutural margin pale. lepida Dej.

bb. Elytra with broad white lobed margin, strongly punctured; densely pubescent beneath.

c. Front glabrous; elytra convex, green, brown or black.

circumpicta Laf.

cc. Front densely pubescent; elytra more flat, brown. togata Laf.

apicalis W. Horn is a synonym of this species and is found in Kansas, while the togata of the K. U. collection is southern in habitat.

REPRESENTATIVE LIFE-HISTORIES.

Cicindela 12-guttata var. C. repanda Dej.

Larva.

External Morphology.

Color yellowish-white, head piceous, thorax medium bronzed. Form rather slender, cylindrical; head and thorax at right angles to the body; last four segments of the body gradually becoming narrower. Length, 7/8 inches.

Head.

Head broader than long, hind angles obtuse; corneous, concave above, a strongly elevated transverse ridge posteriorly. Frontal margin with sides slightly convergent, on each a feeble tooth at base, lateral lobes medium prominent. Head at sides moderately deeply sinuate, hind angles obtusely rounded, suddenly narrowed behind the eyes. Head beneath very convex, with a median line.

Eyes.

Two pair of superior, and two pair secondary eyes. One of the superior eyes situated on the hind angle of the head and the other a short distance in front. One of the secondary eyes is less convex and is on the side of the head just beneath the front superior. The other on the underside of the head below the hind superior eye.

Antennae.

Arise next to the mandibles behind and a little above. They are four-jointed, the first joint stout, the next longer and equal to the next two, which are more slender.

Mandibles.

Fairly slender, falciform, acute and prominent, armed with

acute teeth near the base.

Maxillae.

Small triangular basal piece, second joint (cardinal piece) moderately stout and bearing a few setae; third piece with inner lobe tridentate; the tip moderately long and slender; palpi short, three-jointed.

Labium.

Oval, narrower at base; palpi two-jointed, first joint stout and long.

Prothorax.

Twice as wide as long, concentric, apical margin deeply bisinuate; disc feebly convex; median line finely compressed, a slight sinous on each side, posterior and lateral margins with moderately long whitish hairs.

Mesothorax.

Less than half as wide as prothorax, as wide as long, sides feebly arcuate, surface with single semi-corneous plate with distinct impressed median line.

Metathorax.

About as wide as mesothorax, a little shorter.

Abdomen.

Segments one to four gradually longer; fifth segment longer, gibbous posteriorly and emarginate; on each side of emargination is a tubercle, a hook on each, long and slender and directed upwards and forward; hooks bear a slender spine near tip. Segments six to nine gradually narrowing; anal segment moderately long, truncate, many hairs arising from anterior part of ninth segment on the dorsal side.

Legs.

The legs bear long terminal claws. Middle pair a little the shorter. Coxae conical, followed by a conical joint which is the femur and trochanter combined. Tibia short, cylindrical, followed by a short tarsal piece which gives rise to two fairly long claws of unequal length.

Spiracles.

Nine pair of spiracles. (See description of respiratory system page 19). Plate IV, fig. 1.

Internal Morphology.

The pharynx is a flask-shaped tube with the brain situated at it's neck (Pl. III, fig. 1). Following the pharynx is a slender tube which widens gradually into a considerable one as it passes posteriorly. At a point in this tube, when it passes through the mesothorax, there is a fairly distinct crease followed by a broad canal. This is the proventriculus (Pl. III, fig. 1). The proventriculus is followed by an even broader part of the canal, the ventriculus (Pl. III, fig. 1). The canal then suddenly becomes constricted into a narrow coiled tube, the small intestine (Pl. III, fig. 1). Then comes a sudden widening of the canal which forms the large intestine (Pl. III, fig. 1). This part of the canal is broad at the anterior end and narrower at the base. On the dorsal side of this section, which is a sac-like organ, is a broad and distinct fold, as shown in figure 1, Plate III. Following this is the rectum (Pl. III, fig. 1) leading to the anus. The anterior end of the rectum is narrowed, but widens suddenly before reaching the anus, and

then is suddenly constricted. Running to this widened place on each side of the rectum, are slender longitudinal muscles, and around it are slender circular muscles.

There are four Malpighian tubes, emptying into the canal just back of the proventriculus (Pl. III, fig. 1). These are coiled and very difficult to trace. At many points they are contiguous, appearing at first to have fused. They are colored slightly by the presence of urate-crystals giving them a black mottled appearance.

There is one pair of salivary glands, which empty into the pharynx at its posterior end, through a fine duct leading from each gland. These glands are yellow in color (Pl. III, fig. 1).

Respiratory System.

There are nine pairs of spiracles in all, one in the thorax in the folds of the body wall between the head and prothorax, the other eight located on the abdomen on a dorso-lateral line about equidistant from the dorsum and venter of the segments. The second spiracle is the first abdominal, the ninth the eighth abdominal, spiracle. (Pl. IV, fig. 1).

The tracheae that carry the air to the several parts of the body are made up of two main trunks (Pl. IV, fig. 1), which give off branches. Trunk (a) in the figure runs from one spiracle to another, as does trunk (b). Starting from trunk (b) is branch (e), which runs primarily to the alimentary canal and other organs of the body. It ramifies into many small branches, which not only supply air to the tissues of the organs, but act as a kind of suspensory (Pl. IV, fig. 1).

Branch (f) goes to the ventral side of the alimentary canal and supplies the nervous system primarily. Branch (g) supplies the heart (Pl. IV, fig. 1). All these branches help, in part, to supply the muscular system.

Entering the head from the thoracic spiracle are two large branches (i) and (k) (Pl. IV, fig. 1). These main branches or trunks send our many other branches which supply the brain, eyes, mouth-parts, and muscles of the head.

Branches (o, p, and s) go to the appendages of the thorax, (c and d) supply the muscles around the body wall (Pl. IV, fig. 1).

Nervous System.

The brain is composed of the supraoesophageal ganglion and the suboesophageal ganglion. The supraoesophageal ganglion is composed of two large lobes. Beneath and connected with it, is the single ganglion, the suboesophageal, the two being connected by the crurá cerebri (Pl. IV, fig. 2).

Running backwards and to the sides of it are the optic nerves (a), which terminate in an enlarged lobe (b), from which arise the nerves leading to the eyes. In front of the optic nerves arise the antennal nerves (c) and in front of these are the two small nerves leading to the frontal ganglion (f). (Pl. IV, fig. 2).

The suboesophageal ganglion gives rise anteriorly to two nerves which branch and run to the mandibles, maxillae, and labium. Running posteriorly from this ganglion is the nerve chain (Pl. III, fig. 2).

The nerve chain has three large thoracic ganglia followed by seven abdominal (Pl. III, fig. 2). The first abdominal

ganglion is quite close to the third thoracic. Likewise the sixth and seventh ganglia are quite close together. These ganglia are connected with a double nerve cord. Arising from each of the ganglia are nerves supplying the body in that vicinity. Also from the last abdominal ganglion run long nerves to the caudal end of the body, as shown in figure 2, Plate III.

After many dissections, I was unable to locate the sympathetic system.

Adult.

External Morphology.

Brownish bronze, with a more or less greenish or coppery reflection.

Head.

Granulate rugose front with medium long white hairs. Eyes large and kidney-shaped. Antennae long, filiform, inserted on the front above themandibles. First joint stout, second short and less stout, third longer than first two, the rest of the joints subequal. First four joints glabrous.

Mandibles.

The mandible is powerful and sharp. There is a large, sharp, slender, curved, terminal tooth, followed by three blunt lateral teeth. The prostheca on the ventral side of the mandible bears a row of hairs (Pl. III, figs, 5, 6).

Maxillae.

The lacinia is an elongate slightly curved appendage attached to the anterior lateral side of the stipes. It bears a row of bristles and a stout spine at the tip. The galea is a slender two-jointed appendage, as shown in figure 4, plate V.

Palpi are four-jointed, the fourth joint being quite long. The subtriangular piece is the stipes. Onto this at right angles is fastened the cardo. A few spines are found on the palpus and stipes (Pl. V, fig. 4.

Labrum.

Transversely rectangular, slightly widened through the middle from front to back. On the anterior edge at the middle is a small tooth. Along the anterior dorsal edge are about 12 hairs. Above the labrum is a narrow clypeus. (Pl. V, fig. 2).

Labium.

Leading to the two-winged mentum is a narrow gula. Attached to the outer side of the mentum is the narrow curved submentum. Just back of the triangular shaped portion of the mentum is the glossa, bearing two spines and the paraglossa. The glossa and paraglossa have fused together until they can scarcely be determined. The palpi are three-jointed, the second joint being about seven or eight times as long as the first. The palpi are attached to the palpigers, which appear like one of the segments of the palpi.

Prothorax.

Granulate, brownish, the prothoracic episternum with dense white hairs, cupreous red; disc divided by a faint median line. Front coxal cavities closed, prosternum metallic green, slightly rugose and devoid of hairs.

Elytra.

Granulate punctate, punctures greenish in color; markings, humeral lunule C-shaped, middle band rectangularly bent, connected with a marginal white line which never reaches the

apical lunule. Sides of elytra quite parallel in the male, suddenly dilated before the middle in the female. Tip rounded, serrate, with two short apical teeth, flat or very slightly convex, sides faintly margined.

Mesothorax.

Mesothoracic episternum same color as prothoracic episternum, covered with long white hairs, slightly granulate rugose. Mesosternum without hairs except for a few around the anterior margin, metallic green; epimeron metallic green.

Metathorax.

Metathoracic episternum same color as other episternum, likewise hairy.; metasternum metallic green, with slight pubescence.

Abdomen.

Metallic green, six-segmented in female; sixth segment of male emarginate, exposing the seventh segment, median part with only slight pubescence while along the sides the abdomen is densely pubescent.

Legs.

Front coxa globular and dark metallic green with slight purple tint, covered on the ventral side with long white hairs. Trochanter small joint with white hairs; femura slender with long erect hairs onthe anterior and posterior sides; tibia slender, a little longer than femur, with erect white hairs, and two tibial spurs; tarsi quite long, ending in two long curved tarsal claws; front tarsi of male dilated with short dense pubescence. Length 12 - 13 mm.

HABITS OF THE ADULTS.

Feeding Habits.

The food of the adult is similar to that of the larva. These blood thirsty little creatures rush about the sand flats in search of food and any insect that comes their way, if not too large, is quickly siezed. At Lawrence I observed a great number of these beetles feeding upon maggots, which were on a dead fish on the waters edge. They were also attacking the Muscid adults as well. They would seize a maggot and then crush it with their mandibles, eating all but the chitinous part. This was true of the flies they ate. The flies of course more often escaped, in spite of the sudden dashes of the beetle. In the case of small beetles and spiders, if they do not succeed in catching them the first time, they will wait an instant to allow their prey to stop, and then rush them again and again until caught. When drinking, they press their mandibles into the moist sandy places and suck or lap up the moisture. They never seem to stay long in one place, but rush about in search of prey.

Associates.

The same as the larvae.

Enemies.

At Cimarron, while collecting larvae one morning, I noticed an Asilid flying about where I was working. Suddenly it seized an adult which it quickly killed. I was fortunate in catching it with the beetle still in its grasp. It had thrust its long proboscis between the elytra and was sucking the body juices. The Asilid was *Proctocanthus* near *rufus* sp. Williston.

Hibernation.

The adults pass the winter in burrows in the sand back some distance from the edge of the river. These burrows soon become obliterated and no trace of them can be found. At first they are rough and the openings resemble those of Larrids. The adult goes into the sand some six or eight inches and becomes dormant. When the spring opens and the sun warms the sand, they struggle to the surface. They are a little sluggish at first, but the sun soon awakens them and they fly about. They are at first very wild and hard to catch, but soon become less irritable and can be readily caught.

General Life Histories.

Although I attempted to rear C. cuprascens and C. 12-guttata, var. repanda from the adults, I was unsuccessful. The following is from the writer's observations and Dr. V. E. Shelford's paper on the immature stages.

Oviposition.

Although no eggs were found, I have observed the female in the process of attempting oviposition. She ran about the cage testing the sand with her ovipositor. At times she would elevate the anterior portion of her body, protrude the ovipositor and thrust it into the sand. Dr. Shelford states that a female lays one egg in a hole 7 to 9 mm. deep, made by her ovipositor. C. purpurea lays about 50 eggs, but it is not known whether more than one batch is deposited.

Egg.

The eggs are ovoid, elongate, 1.5 mm. in length and 1 mm. diameter. They were found in the body of an adult C. 12-guttata, var. repanda.

Copulation.

At Cimarron great numbers of C. 12-guttata, var. repanda, C. cuprascens, and especially C. hirticollis were in the act of mating. They were running about in coitu andthe male would not leave the female unless in imminent danger, returning as soon as the danger had passed. The act of copulation is carried on in the following manner: the male approaches the female, and suddenly seizes her at the base of the elytra with his powerful mandibles. The ventral side of his body rests upon the elytra of the female. His legs are spread out at the sides as if to balance and steady him. In this position the female carries her mate about for long periods, although actual copulation lasts but a short time. He will remain in this position even when captured, but then will let go and attempt to escape. In actual copulation they are quiet; at other times he rides on the female while she runs about feeding and seems quite unconcerned as to his presence.

The act of copulation consists of many efforts of the male to insert thepenis. When successful, there is a single thrust, in which the actual connection lasts for a minute or less. There may be more than one successful attempt. The pair that I am discussing was of the species C. cuprascens, captured in mid-September, on the sand flat of the Kaw river at Lawrence and kept on my desk in the laboratory. No more species were seen mating, although many individuals were present.

A brief account of the length of periods of the egg, larvae, pupae and adult as Dr. Shelford has given for C. purpurea will be included. The egg stage lasts about two weeks,

the young larvae making a small burrow upon hatching. First larval stage three or four weeks, second larval stage about five weeks, last larval stage from the last of August or first of September to the following April. In this time the larvae have hibernated. Upon appearing again about April, they feed voraciously and then occurs the pupal ecdysis, when the pupa emerges from the larval skin. This lasts but a short time. The pupal stage occupies some two weeks, followed by the last ecdysis and then the imago appears. Just before the pupal stage, the larvae become quite sluggish and the end of the burrow is enlarged considerably. This was observed at Larned in a dark sandy bank of the Arkansas River.

HABITS OF THE LARVAE.

Burrows.

The larvae of this species were found in great numbers by the writer at Cimarron, Larned, and Hutchinson, in burrows on the sand flats of the Arkansas River. At Cimarron they were in great numbers and many specimens were secured. When not at the opening of their burrows, they could be dug out with a small trowel. Often larvae could be coaxed to the opening by passing a small shadow over the opening, and then could be dug out by quickly thrusting the trowel beneath them, before they could retreat. Then on throwing the sand aside, the wriggling scrappy little fellow could be taken.

The burrows are found in colonies, or separated for some distance. Theopenings are smooth and about one to two sixteenths of an inch in diameter and four to twelve inches deep. The debris and sand is removed by flipping it away with the head. At Lawrence little balls of sand and debris thrown

out by the larvae have been found from a half inch to about six inches around the opening of the burrows. They used their heads as small tamps to shape up their burrows, which are very smooth. These burrows go down straight in some cases, and at an angle in others. When they are ready to pupate, the bottom of the burrow for about one or one and a half inches is enlarged.

Feeding Habits.

The food of these larvae consists of flies, small beetles, spiders and larvae of all sorts. Any of these that happen to be so unfortunate as to cross the opening of the burrow is liable to be caught by the powerful jaws, and eaten. Should the victim try to escape, the larvae are held in the burrow by the long recurved spines on the tubercles of the fifth segment. These larvae can go for a week, without dying of hunger. Those in captivity, when starved this way, grasp flies or other insects given them and eat voraciously. When one meal is finished, they are at the mouth of the burrow waiting for more.

Associates.

These were the same as those of the adults. At Cimarron I found spiders, beetles, Carabidae (Bembidium, Clivina and Dyschirius), Heteroceridae, Hymenoptera (Larridae) and Diptera, Tipulidae (Empedomorpha empedoides Alex.).

In addition to the above, at Larned I found Gelastocoridae, Saldidae, and the Bombyliid fly Spogostylum anale. The larvae of this Bombyliid are parasitic on the Cicindela larvae. (Ann. Ent. Soc. Am. vol. 1, p. 30). The eggs are laid on the Cicindela larvae in July or August. The larvae of this fly are

on the last larval stages of the host in the spring, at which time when the host makes its pupal cell, the internal parts become semi-fluid, the parasite molts, grows rapidly and destroys its host (July). The pupae then make their way to the surface by a wriggling motion, and the adults emerge when the surface is reached.

At Hutchinson the only additional associates were a great number of Muscid flies.

The same thing was found to be true of those foundon the sand flats of the Kaw river at Lawrence.

None of our Kansas forms have an economic significance. However, there are some arboreal forms, such as the Collyris mentioned by R. Shelford, which do. This larva makes its burrows in the stems of coffee plants and is an agricultural pest in the East Indies. Its methods of feeding are the same as Cicindela.

DESCRIPTION OF THE KANSAS SPECIES.

1. Amblycheila cylindriformis Say.

Black, elytra brown to nearly black in some cases; head large, eyes small; labial palpi shorter than maxillary with first joint concealed partly by the mentum, third and fourth joints elongate, mandibles with three moderately acute lateral teeth and one moderately long apical tooth, labrum bidentate at middle; thorax and underside smooth; elytra with three carinae at each side, unequal punctures; legs long and robust, tarsi moderately short; wingless. Length 30 - 38 mm.

Male. Hind trochanter acute with two grooves, last ventral segment broadly rounded with large setigerous punctures on each side of the middle.

Female. Hind trochanter shorter, oval, obtuse at tip, last ventral segment somewhat prominent in middle and sinuate at each side with feeblemedian ridge.

Habitat. Colorado, Kansas, Oklahoma, New Mexico, eastern Arizona and Texas. Western Kansas south of the Smoky Hill River, June, July and August.

Say Journ. Ac. Phil. 1822, 111.139; Trans. Am. Phil., new ser. IV. 409 (emend); Thoms., Mon. p. 14, pl. 3, fig. 3; Lec. Col. of Kansas, p. 1, pl. 2, fig. 1; Horn, Trans. Am. Ent. Soc., V. 233 (on sexual characters, etc.); Trans. Am. Ent. Soc. VII, 28 (on the larvae).

Early History of Amblycheila cylindriformis Say.

"In 1823 the famous entomologist Thomas Say, discovered a single dead specimen of this insect 'near the base of the Rocky Mountains'. Twenty-nine years later a second specimen, also dead, was found upon the 'Llanos Estacados' or Staked Plains by one of the United States Surverying Expeditions. The remarkable structure and great rarity of this beetle made it 'facile princeps' among American insects, and its possession

was eagerly sought by our foremost entomologists. But many difficulties lay in the pathway of those who would gain the coveted prize. The region in which the two specimens had been captured were practically inaccessable to the entomologist. No railroad had then entered the vast country lying west of the Missouri River, and hostile bands of Indians were at all times in readiness to massacre the reckless adventurers who should dare to traverse their hunting grounds without a powerful military escort. But notwithstanding the inaccessibility of the plains to collectors of insects, various attempts were made to overcome this difficulty. A distinguished American entomologist, not many years after the discovery of the second specimen of Amblychila, in 1852, printed a circular containing a description and life sized figure of the beetle, which he distributed among the army surgeons at the various military posts in the Western territories. Several additional specimens were obtained in this way, and several others were brought in by some of the more recent Government expeditions. But Amblychila cylindriformis continued to be the rarest and costliest of American insects. It could hardly be purchased for museums at any price, and not more than two years ago, no less than fifteen or twenty dollars were eargerly paid for a single specimen. Indeed, a price list of North American Coleoptera issued at Cambridge only eight months ago, quotes them at twelve dollars per specimen."

Two facts led to the discovery that this insect was by no means as rare as supposed at that time; one that the Indians were removed to distant reservations; the other the discovery of the crepuscular and nocturnal habits of Amblycheila. This led to the discovery of a great number of specimens during the years 1876 and 1877. In 1876 Messrs. H. A. Brous and S. W. Williston, of the Yale College Geological Expedition in charge of Prof. B. F. Mudge, obtained about 100 specimens. During 1877, Messrs. Williston and Cooper of the Yale Expedition, and the Kansas University Expedition under Prof. Snow, collected several hundred specimens. Prof. Snow found that this insect may be abundant one year and then become comparatively rare the next year or so. When this great catch was made the price of Amblycheila at once dropped from twelve to one dollar per specimen. The Snow collection was greatly increased by the sale and exchange of this much sought for insect. (Trans. Kans. Ac. Sc. VI, 30-32).

Later observations of this beetle were made by the members of the Kansas University expedition in 1910 in Wallace County. (Ent. News, XXV, vol. 2).

These insects are lacking in the ferocious nature ascribed to them by early writers. They come forth at night, soon after sun-down, in quest of food, and search through the night, Their sense of sight is very poor for the seem never to see their prey at a distance, and never capture it unless they stumble onto it as if by accident, at which time they quickly seize it with their long mandibles and suck the body juices from the struggling victim. Their lack of vision is further demonstrated by the fact that they do not try to escape when about to be captured. One can come very close to them before they will run, but when taken they will try to escape. As soon as daylight approaches they hurry to their hiding places.

Amblycheila is found in the sloping clay banks of western Kansas in Wallace, Gove, Greeley, Grant, Morton, Meade and Stanton Counties. In general, from the Smoky Hill River southward in western Kansas.

The adult passes the day in burrows made by other animals, especially the winding burrows of the kangaroo rat. They share these burrows with Eleodes, Pasimachus, etc., and probably make a noon day meal of these insects. (Kans. Ac. Sc. VI, 31).

In regard to food nearly any insect satisfies them. They seem to be especially fond of all sorts of Orthoptera, Lepidopterous larvae, etc. They eagerly devour the huge wingless locust (Brachystola). Pentatomids and Polistes are not relished. In captivity, they thrive on Dryocampa rubicunda, var. alba, and Datana ministra.

Conversely, Amblycheila is the food of the skunk. This fact was found to be true by Mr. Walker of the Kansas University survey party during 1877. While collecting, he discovered the remains of these beetles and upon further investigation found a skunk going along devouring what might have gone the way of the collecting bottle. The following morning Mr. Foster of the same party killed the animal and upon examination of the contents of its stomach, freshly eaten Amblycheila were found (Tr. Kan. Ac. Sc. VI, p. 32). The only Nebraska record of Amblycheila is based on a specimen taken from a hawk.

Larvae, their burrows and feeding habits.

These larvae are much like theother Cicindelinae in form and habits, but larger. The observations made during the summer of 1910 by the Kansas University Survey party shows them to be widely distributed in Wallace, Wichita and Morton counties.

They were found in colonies of two to eleven in an area that could be 'circumscribed in a radius of ten inches'. (Can. Ent. XXV. 4.).

There were two sizes of burrows, one with larvae about a half inch long and the other with larvae about two inches long. The short larvae had burrowsabout four inches deep while the larger were about thirty inches deep. These burrows go down for 18 inches quite perpendicular, and the remainder of the way at an angle of about 45 . The last ten inches or so are somewhat enlarged, and the bottom is full of refuse. Some of the colonies were located on the brows of hills, while others were back on the plains.

After many observations were made by this party, the larvae were found to be general feeders. They accepted such insects as Lachnosterna, Litaneutria, moths, Pasimachus and Cicindela.

They have the habit of closing their burrows at times, This is similar to Cicindela purpurea, which does so at the time it molts. (Can. Ent. XXV. 5).

Tetracha virginica (Linn.) 1766.

Dark golden green; last ventral segment, antennae, mouth-parts and legs ferrugineous; head and thorax smooth, elytra coarsely punctured; broad lateral margins of thorax and elytra light green, disk black.

Head a little longer than broad, moderately convex and smooth, shining; labrum brown, rectangular; thorax broadly heart-shaped, disc elevated, with an anterior and posterior impressed transverse line and a distinct triangular impression about the center of the disc; elytra slightly convex, broader than base of thorax, basal two thirds deeply and coarsely punctured, black at the middle and sides with metallic green stripe; legs, antennae, mouth-parts and last one or two ventral segments brownish yellow. Length 20 - 24 mm.

Habitat. General through the state; specimens in Snow collection from Elk, Neosha, Labette, Cherokee, Anderson and Couglass Counties.

Linn. Syst. Nat., 11, p. 567; Thoms., l. c. p. 41, pl. 7; Horn, Trans. Am. Ent. Soc. V. p. 234 (sexual characters).

Cicindela formosa Say 1817.

Red cupreous, beneath metallic blue; head granulate rugose, hairy; thorax broader than long, granulate; humeral lunule, middle band and apical lunule quite broad and connected at the margin. Middle band often obtusely bent and varied in shape; abdomen stout, under side hairy; labrum distinctly three-toothed. Length 15 - 18 mm.

Mostly eastern in distribution, Harper, Phillips, Clark, Rookes, Morton, Hamilton and Wallace Counties.

Say Journ. Acad. Nat. Sc. Phil. I. 422; Am. Ent. I, 35, pl. 18, fig. 2; Dej. Spec. II, 424; Lec. Am. Lyc. IV, 180.

Aber. C. Generosa, Dejean, 1831.

Purple cupreous, metallic blue beneath, hairy; head granulate rugose, hairy; thorax granulate rugose and hairy, narrowing behind; humeral lunule, middle band and apical lunule broad, connected at the margin. Length 13 - 15 mm.

Ranges throughout the eastern part of the state. The Snow collection has one specimen from Douglas County.

Dej. Spec. V. 231. Gould Boston Journ. I. 42. pl. 3. f.2.

C. lengi W. Horn, 1908.

Head and thorax greenish bronze, elytra purplish brown, beneath bluish green; medium hairy beneath; head granulate rugose, thorax slightly granulate and rugose; humeral lunule extending inwardly at an angle posteriorly, connected by a marginal line with the middle band which is similar to that in hirticollis but stouter; apical lunule stout and connected with

the middle band. Length 12 - 13 mm.

Central and western in range. Specimens in the Snow collection from Trego County.

W. Horn Deutsche Ent. Zeit. 1908.

The species "venusta" described by Le Conte in 1848, is a synonym, the name being preoccupied by a variety of "dorsalis" described by Laferte in 1841.

C. purpurea Olivier, 1790.

This species is variable both in color and markings. Reddish supreous, margins brilliant green, beneath bluish green with some cupreous tinge; head rugose, hairy, labrum three-toothed; thorax granulate, flanks, front of head and middle coxae rather densely clothed with long white hairs; elytra moderately punctured and granulate, suture and exterior submargins green; the markings consist of an oblique scarcely sinuate middle band not extending to the margin and an apical dot. Length 12 - 15 mm.

Found in eastern and central Kansas along clay and red sandy roads. Taken at Manhattan and near Salina.

Olivier Ent. II, 33, p. 14, pl. 3, f. 34; Say Trans. Am. Phil. Soc. new ser. I, 419. Lec. Ann. Lyc. IV. 176; Can. Ent. vol. 32, p. 112. Bull. Brlyn. Ent. Soc. IV. 89.

Aber. C. auduboni Leconte, 1856.

This is the black variety of "purpurea", there being a green variety described by Le Conte in 1845. The insect is black with a blue margin and blue beneath; the markings are the same as in purpurea. Length 14 - 15 mm.

Found on open clay bottoms near chalk washes in central and eastern Kansas. Recorded as far west as Clark County.

Lec. Boston Journ. V. 207, pl. 18, fig. 7. Kansas Ac. Sc. VI, 32, Can. Ent. 32, p. 112.

Aber. C. graminea Schaupp. ex parte 1883-1884.

This is a greenish variety of purpurea with a cupreous tinge on the thorax and margin of elytra; it has the same markings as purpurea with the anteapical dot sometimes present. Length 14 - 16 mm.

Ranges the same as auduboni.

Brooklyn Ent. Soc. Bull. VI, p. 90. Can. Ent. 32. p. 112.

Subsp. C. purpurea splendida Hentz, 1830.

Head and thorax green or blut, elytra cupreous, with short middle band and apical dot; under surface and margins green. The species exhibits great variation, some Texas specimens lacking markings, some having only the apical dot, some with only a tiny spot at the middle of the margin and still others having four marginal dots and the middle band. Length 14 - 15 mm.

Found in the same locality as purpurea and on sand-dunes with C. scutellaris. Topeka and eastward.

Hentz Trans. Am. Philos. Soc. III, 254, p. 2. Bull. Brklyn. Ent. Soc. VI, 90.

Aber. C. transversa Leng, 1902.

This is a red form of purpurea. The middle band is

smaller and less complete; the posthumeral and humeral dot may be lacking or there may be only a faint middle band and apical dot. Length 14 - 15 mm.

Western Kansas.

Aber. C. denverensis Casey, 1897.

Green or bluish green; green beneath; head rugose and hairy; thorax rugose, flanks hairy; elytra granulate and faintly punctured. The markings are a slender middle band, apical dot, and the anteapical mark lacking in some cases; margins bright green. This is a green form of purpurea. Length 14 - 15 mm.

The aberration has been taken in Clark and Hamilton Counties; it is southern and western in its distribution.

Casey Ann. N.Y. Ac. IX, p. 297.

Subsp. C. purpurea limbalis Klug, 1848.

Same as amoena Leconte 1848, the latter being a synonym. The specimens in the Snow collection have the head and thorax purplish or greenish and the elytra cupreous; margins and under surface green; the markings consist of a humeral dot, an oblique middle band, posthumeral dot, anteapical dot and apical dot. Length 13 - 14 mm.

Topeka and eastward on sandy river flats.

Klug. Jahrb. I. 29. Genera Insectorum 82a, b, c.

C. duodecemguttata Dejean, 1825.

Brownish bronze; elytral markings consist of humeral, posthumeral, apical and anteapical and upper discal dots and a very narrow middle band scarcely reaching the discal dot. It is very closely related to its varietal form, repanda, "It differs in that the thorax is more flattened, shorter and less convex, the elytra of the female is only gradually dilated." (Leng). Dorsally the color is blacker than in repanda. The C-shaped humeral lunule is not present, represented only by a dot, behind which is the posthumeral dot of about the same size. The middle band is narrower than in repanda but similar in form. A very small marginal line is sometimes present although often lacking. The upper discal dot in some cases is connected with the middle band, but often this is not so. The apical and anteapical dots are present but seldom connected. Length 12 - 15 mm.

Prefers wet muddy spots on sand bars. Eastern and central in distribution, having been taken in Douglas, Johnson and Salina Counties.

Dej. Spec. Col. I. 74, Bul. Brklyn. Ent. Soc. VI. 95.

Subsp. C. duodecem guttata repanda Dejean, 1825.

Brownish bronze with a coppery hue, beneath green; head granulate, hairy; labrum short and one-toothed; thorax nearly square, slightly narrowed behind, granulate; elytra punctured and granulate, humeral lunule C-shaped; middle band rectangular bent, connected with marginal white line which nearly attains the margin but never entirely so. Length 12 - 14 mm.

Occurs on sand banks and bars throughout the state. Recorded in the Snow collection from Wallace, Barber, Douglas, Grey, Pawnee, and Reno Counties.

Dejean. Spec. I. 74. Bull. Brklyn. Ent. Soc. VI. 94. Lec. Ann. Lyc. 4, 180.

Aber. C. unijuncta Casey, 1897.

A form of repanda with partial confluence of markings at the margin.

C. hirticollis Say, 1817.

Dull brownish bronze with a slight greenish tinge, beneath green and very hairy; head rugose and granulate; front hairy, labrum one-toothed; thorax quadrate, flat and hairy; elytra granulate-punctate, dilated before the middle in both sexes; humeral lunule bent upward at its posterior extremity and connected with the middle band by a marginal line; the marginal line is usually broken before the apical lunule. This form has the markings uniformly widened. Length 13 - 15 mm.

Say Trans. Am. Philos. Soc. new ser. 1818, I, 411, pl. 13, f. 2. Bull. Brklyn. Ent. Soc. VI. 96. Blatchley Coleop. of Ind. Bull. I. 35.

Found throughout the state, its range being coincident with that of repanda. Collected in Douglas, Reno, Gray, and Pawnee Counties.

Aber. C. ponderosa Thomson, 1859.

This is a form of hirticollis with markings uniformly widened. Dull reddish brown with slight cupreous tinge; head granulate rugose, hairy; labrum with a prominent, short median tooth; thorax rugose, granulate, hairy; elytra strongly punctured with intermixed granules; markings as in hirticollis; tip of elytra slightly more acute than in hirticollis. Length 15 - 16 mm.

Found on sand banks in southern Kansas, south of Arkansas River.

Thoms. Arc. Nat. 1859. p. 89.

C. tranquebarica Herbst, 1806.

Our Kansas specimens are brown-bronze above, green beneath; head rugose, granulate and hairy, labrum short, three-toothed; thorax granulate and somewhat punctate; elytra granulate punctate, humeral lunule oblique, very much prolongated, middle band narrow, rectangular, bent, but a little expanded at the margin, apical lunule normal; some specimens have a greenish tinge. Length 13 - 16 mm.

General in distribution, but more especially in central and eastern Kansas.

Herbst Col. X. 178. pl. 171. f. 12. Bull. Brklyn. Ent. Soc. VI. 94. Can. Ent. Vol. 32. p. 113.

C. vulgaris Say is a synonym.

C. fulgida Say, 1823.

Red cupreous, brightly shining; beneath hairy and green; head rugose and hairy in front; labrum short, three-toothed; thorax rugose, with impressed transverse lines blue; elytra densely punctured, granulated between the punctures; humeral lunule dilated, a wide angular refracted middle band, apical lunule connected with anteapical dot, middle band never connected with humeral and apical lunules. Length 11 - 12 mm.

Found in central and western Kansas in salt marshes. Recorded from Wallace, Hamilton, and Clark Counties.

Say Journ. Acad. Nat. Sc. Phil. III, 141; Lec. Lyc. IV. 179, pl. 13, f. 5. Bull. Bfklyn. Ent. Soc. VI. 92.

C. pulchra Say, 1823.

Red-cupreous, highly polished with blue or green margins, beneath greenish blue; head often with greenish tinge on the front, hairy; labrum short, wide, andslightly three-toothed; thorax rugose in cases with a green tinge; elytra polished, quite densely punctured at base but becoming less so at the tips; a transverse middle line or dot in cases, and sometimes a round humeral dot. Length 20 - 23 mm.

This is a western species found south of Smoky Hill River. Recorded from Stanton, Hamilton, and Wallace Counties.

Say Journ. Acad. Nat. Sc. Phil. III, 142; Lec. Ed. II. 91; Dej. Spec. II. 421; Lec. Ann. Lyc. IV. 175. Can. Ent. vol. 32. p. 111.

C. scutellaris Say, 1823.

Head and thorax blue or green, elytra reddish or greenish

brassy, green in the middle of the base; head hairy, rugose, labrum three-toothed, dark in color; thorax convex and wider than long, densely and finely rugose, hairy; elytra finely granulate with a few obsolete punctures near the base; although markings sometimes are present, none were found in the specimens observed by the writer; outer side of middle tibia densely pubescent. Length 12mm.

Ranges west from Manhattan in sandy places. Possibly not in northwestern part of state. Recorded from Clark, Trego, Gove and Finney Counties.

Say Journ. Ac. Nat. Sc. Phil. III, 140; Lec. Am. Lyc. IV, 176, pl. 13, f. 2. Bull. Brklyn. Ent. Soc. VI. 87.

C. lecontei Hald.

Recorded from this state, and is a synonym of the subspecies modesta Dej. of the present species. The head and thorax are greenish, elytra purplish or coppery bronze with a little green at the base. There is an apical lunule, marginal line or two or sometimes reduced to dots, humeral dots in some cases. Length 11 - 12 mm.

These are found in Douglas County, at Manhattan, along the Republican River and south on the sand hills and salt marshes of Reno County near Medora.

C. sexguttata Fab. 1775.

Green above and below, often with a strong bluish reflection; head rugose, bald, labrum three-toothed; thorax rugose, cordate; elytra strongly punctured, with a marginal, anteapical, apical

and sometimes a discal dot. Length 10 - 14 mm.

Fab. Syst. Ent. p. 226; Say Trans. Am. Philos. Soc., new ser. 1818, 1, 414, pl. 13, f. 4; Dej. Spec. 153; Lec. Am. Lyc. IV, 176, Can. Ent. vol. 32, p. 111.

Aber. C. violacea Fab. 1801.

Bluish green, with a slight purplish tinge at base of elytra; beneath similar in color; legs purplish color; thorax granulate punctate, narrowed behind; elytra granulate punctate. A very faint marginal dot is sometimes found. Length 12 - 13 mm.

An eastern Kansas species. Specimens from Onaga, Pottawattomie County,

Fab. Syst. El. I, 232. Can. Ent. Vol. 32, 111.

C. obsoleta Say, 1823.

Black, sericeus in some cases; black beneath; head glabrous, slightly rugose; labrum five-toothed; thorax trapezoidal, flat, smooth, with a few hairs at the sides; elytra indistinctly punctured, an apical spur on each elytron; markings an obsolete apical dusky dot, or else black, immaculate. Length 16 - 20 mm.

The only record is from Hamilton County.

Say Journ. Ac. Philad. III, 143; Lec. Ann. Lyc. IV, 178, p. 113, f. 4.

C. punctulata Olivier, 1790.

Slender, subcylindrical; black, dark brown or greenish

bronze above, greenish beneath; head and thorax finely granulate rugose, sparsely hairy; elytra nearly oblong but slightly widened about mid-length, strongly and densely punctured with a row of large bluish foveae near the suture. Apical lunule usually complete; humeral dot sometimes present, posthumeral sometimes; an interrupted middle band usually, with part of middle band and a discoidal dot on each elytron. Length 12.5 - 15 mm.

Found generally through the state on hard packed roads and paths, around electric lights, and the dried or damp muddy bottoms of rivers and ponds.

Oliv. Ent. II, 33. p. 27, pl. 3, f. 37 a.b.; Fab. Syst. El. 1241; Dej. Spec. 101; Say Trans. Am. Philos. Soc. new ser. L, 238.

Aber. C. chihuahuae Bates, 1890.

A greenish blue form; head and thorax sometimes bronzed; markings the same as in punctulata. The former species micans, described by Fabricius in 1798, is a synonym of punctulata. What has been called micans in our collection is chihuahuae Bates. Length 12 - 14 mm.

Western and central in range. Recorded from Russell, Sheridan, Seward, Comanchee, Barber, Morton, Greeley and Harper Counties.

Bates Ent. XXIII, p. 500.

C. celeripes LeConte, 1848.

Brown bronze, hairy beneath; head granulate rugose, eyes large, labrum with single tooth; thorax long, cylindrical, granulate rugose; elytra with humeral angle wanting or very slight, widens gradually from anterior to posterior of the middle where it again begins to narrow, faintly margined, each elytron bears an apical spur, markings vary in prominence, a dot representing the tip of the humeral lunule and discoidal in position, a marginal line near the middle, a discal dot and a faint apical lunule; legs long and slender; Length 7 - 8.5 mm.

Taken at Manhattan, Kansas; Potawattomie, Clay and Republic Counties.

LeConte Ann. Lyc. Nat. Hist. N.Y. 1848. IV, 183, pl. 14, f. 14. Bull. Brklyn. Ent. Soc. VI. 85.

C. circumpicta Laferte, 1841.

Green, bluish or dark brown, beneath dark greenish bronze, densely pubescent at the sides; head moderately rugose, granulate and glabrous, labrum three-toothed; thorax very shiny, convex and much rounded at the sides; elytra nearly parallel in both sexes, strongly punctured, especially near the base, with a broad white margin more or less lobed internally to indicate the posterior portion of the humeral and the anterior portion of the apical lunules and the middle fascia; eyes large and prominent. Length 14 - 14.5 mm.

Recorded from Wallace, Gove, and Clark Counties, in the neighborhood of salt marshes.

Laferte Rev. et. Mag. Zool. 1814. p. 39 and 193..

C. nevadica subsp. knausii Leng, 1902.

This is a variety of nevadica with fully developed normal markings; it varies in color from a dark bronze to a bluish green. Length 10 - 13 mm.

Found in salt marshes from Republic County eastward.

Leng Trans. Am. Ent. Soc. XXXV. p. 166. Bull. Brklyn. Ent. Soc. VI. 101.

C. cuprascens LeConte, 1852.

Coppery or greenish bronze, shining, beneath green bronze, very hairy at sides; head and thorax hairy, labrum short, one-toothed; elytra more coarsely and densely punctured, with basal dot, and white lobed margin; a humeral lunule, suboblique, hooked at tip; a middle band somewhat tortuous and a little confused before the tip which is dilated, and an apical lunule inflected at both ends. Length 12 - 14 mm.

Recorded from Douglas, Clark, Sedgwick, Barber, Gray and Pawnee Counties. At Lawrence, Topeka, and Hutchinson, it was noted on sand flats of rivers.

Lec. Proc. Ac. Nat. Hist. Phil. 1852. p. 65. Blatchley's Coleoptera of Indiana. Vol. i, p. 35. Can. Ent. vol. 32, p. 114.

Subsp. C. cuprascens macra LeConte, 1856.

Bronze brown with faint greenish tint; beneath bronze or greenish bronze, densely pubescent at the sides; head and thorax pubescent, labrum one-toothed; elytra finely and sparsely

punctured, markings similar to those of cuprascens, the tip of the middle fascia dilated into a fairly triangular spot; tooth of female rather obtuse in macra, the tip slightly prolonged; suture spinous, tip of female slightly prolonged. Length 13 - 14 mm.

Range the same as cuprascens.

Lec. Trans. Am. Philos. Soc. 1856. XI. 50.

C. lepida Dejean, 1831.

Head and thorax greenish bronze, hairy; elytra white glabrous, dispersely punctured with a few green or bronze lines; suture pale; beneath greenish bronze and densely clothed with white hairs; legs, antennae and palpi pale; labrum one-toothed; elytra of female at apex deeply sinuate, in male truncate. Length 11 - 12 mm.

Found from the Smoky Hill River southwestward on white sandy areas.

Dej. Spec. Col. V. 255; Lec. Ann. Lyc. IV. 181. pl. 13, f. 8.

C. apicalis W. Horn, 1897.

Synonym of the subspecies globicollis Casey of C. togata Laferte 1841.

C. belfragei Salle, 1877.

Black with sometimes a dark blue; shining black beneath; head large, smooth, labrum advanced, medially three-teeth; thorax cylindrical, a little longer than broad, with faint

impressions; humeral angle lacking, elytra twice as long as broad, oval and with no green punctures as in pilatei, wings lacking. Length 12 - 15 mm.

Recorded from Sumner, Cowley and Riley Counties.

Bull. Soc. Ent. Fr. 1877. p. 6; Bull. Brklyn. Ent. Soc. VI. 85.

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PLATE I.

When the markings are in bands as Fig. 3. (C. repanda).

1 - Humeral lunule.

2 - Marginal line.

3 - Middle band.

4 - Apical lunule.

When the markings are in dots as in Fig. 4.

5 - Basal dot (as in fig. 1, C. cuprascens).

6 - Humeral dot.

7 - Posthumeral dot.

8 - Marginal dot.

9 - Supplementary dot.

10 - Discal dot.

11 - Anteapical dot.

12 - Apical dot.

When these markings are of the style shown in Fig. 2, (C. hirticollis) they are said to be complete; when lacking in part or broken up into dots they are called incomplete. Blatchley's Coleoptera of Indiana.

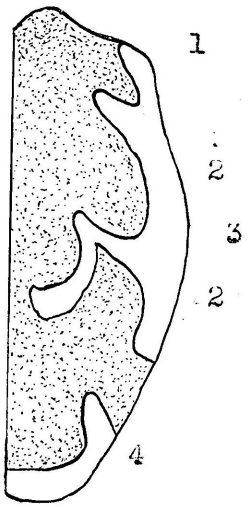


Fig.1.

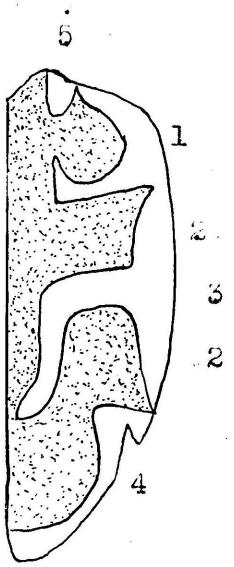


Fig.2.

(after Blatchley)

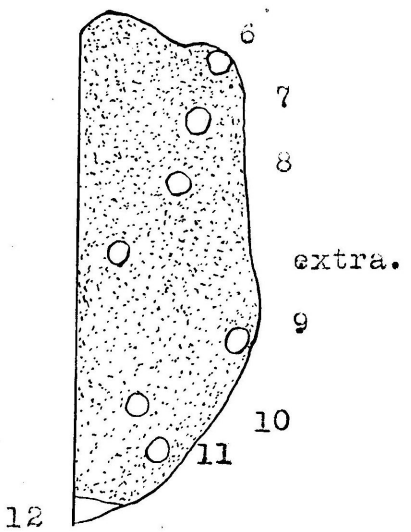


Fig.3.

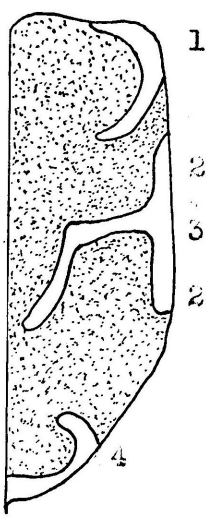


Fig.4.

PLATE II.

Dorsal Aspect of the Adult of *Cicindela 12-guttata*, subspecies, *C. repanda*.

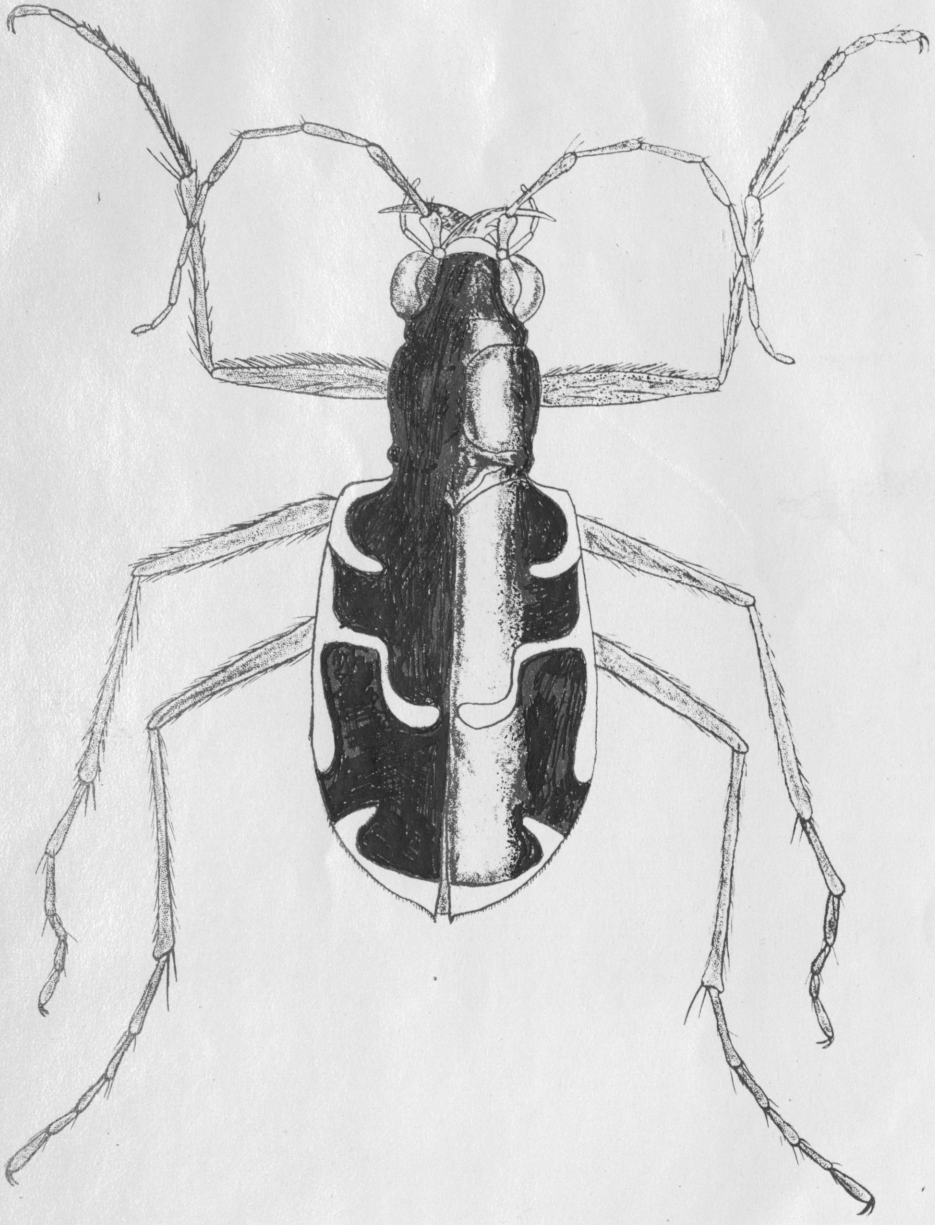


PLATE III.

Fig. 1. Alimentary Canal, C. repanda.

p. Pharynx.

b. Brain.

s.g. Salivary Glands.

oe. Oesophagus.

s.s. Simple Suspensory Muscle.

b.s. Branched Suspensory Muscle.

p.v. Proventriculus.

m.t. Malpighian Tubes.

s.i. Small Intestine.

l.i. Large Intestine.

r. Rectum.

Fig. 2. Ventral Nerve Cord with Brain.

s. Supraoesophageal Ganglion.

s.u. Suboesophageal Ganglion.

I. First Thoracic Ganglion.

II. Second Thoracic Ganglion.

III. Third Thoracic Ganglion.

1-7. Abdominal Ganglia.

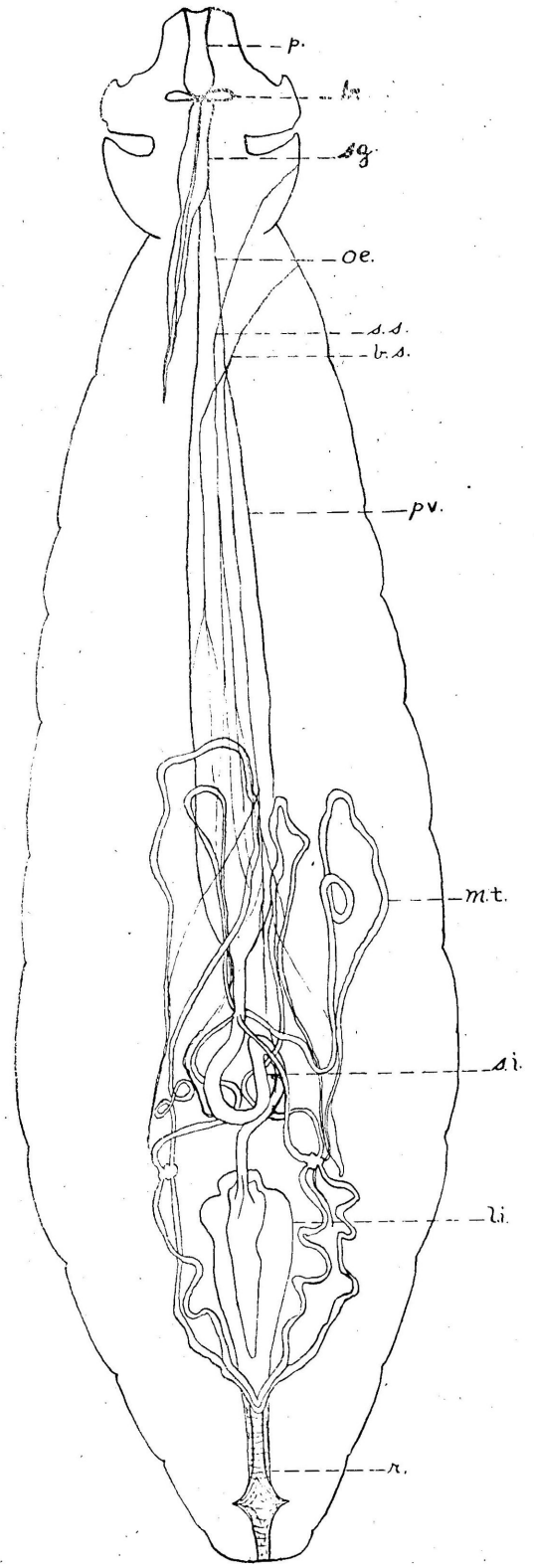


Fig. 1.

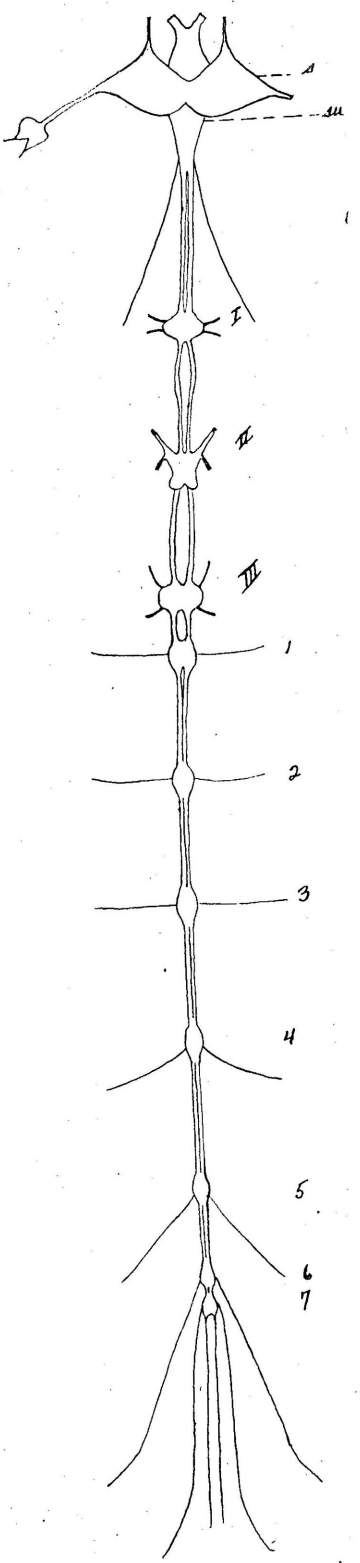


Fig. 2.

PLATE IV.

Fig. 1. Respiratory System of Larva of C. repanda.

Pro. Prothorax.

Mes. Mesothorax.

Met. Metathorax.

1-9. Abdominal Segments.

a,b. Branches between Spiracles.

c,d. To side of the Body of Larva.

e. Primarily to the Alimentary Canal.

f. To ventral side of Alimentary Canal and Nerve Cord.

g. Supplies the Heart.

1'-9'. Point where Main Trunks connect with Spiracles.

i,k. Two large Branches from Thorax to Head.

o,p,s. To the Appendages of the Thorax.

m,n,l. Supply the several parts of the Head.

r,q,j. Supply the Prothorax and some of its Muscles.

Fig. 2. Brain or Supraoesophageal Ganglion and the Frontal Ganglion.

a. Optic Nerve.

b. Enlarged Lobe just before the Nerve goes to the Eye.

c. Antennal Nerve.

d. Nerve to Frontal Ganglia.

e. Frontal Ganglia.

f. Nerves leading to the Mouth-parts.

Fig. 3. Dorsal view of the Larva of C. repanda.

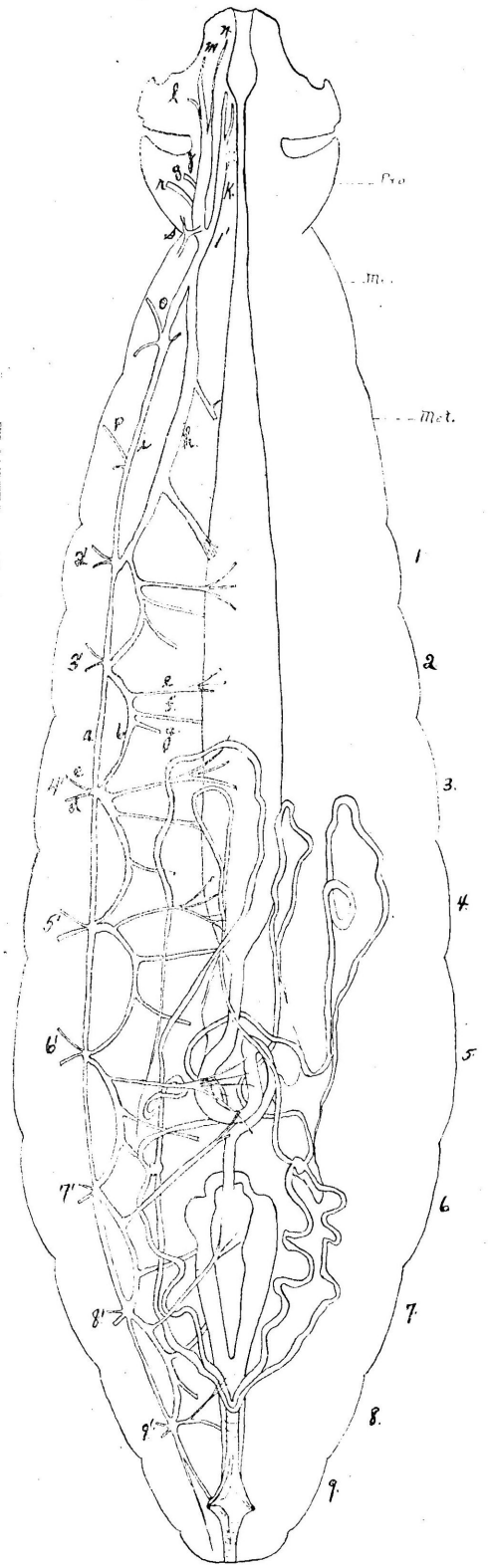
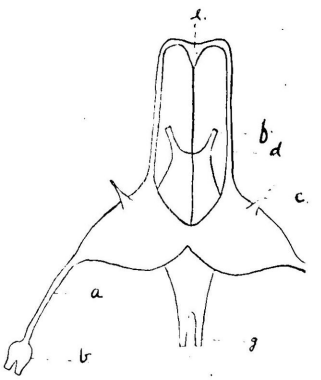


Fig. 1.



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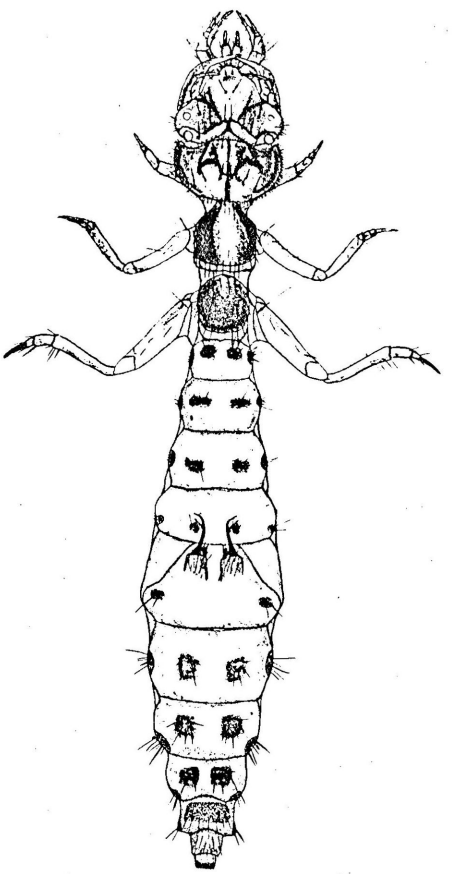

Fig. 3.

PLATE V.

Fig. 1. Lateral view of the Larva of C. repanda.

Fig. 2. Labrum of Adult of C. repanda with the clypeus (c).

Fig. 3. Labium of Adult of C. repanda.

- p. Palpus.
- 1st. First joint of Palpus.
- pg. Palpiger.
- g. Glossa.
- pgl. Paraglossa.
- sm. Submentum.
- m. Mentum.
- gu. Gula.

Fig. 4. Maxillae of Adult of C. repanda.

- p. Palpus.
- g. Galea.
- l. Lacinia.
- s. Stipes.
- c. cardo.

Fig. 5. Mandible of Adult of C. repanda, right dorsal.

Fig. 6. Mandible of Adult of C. repanda, left ventral.

Fig. 1

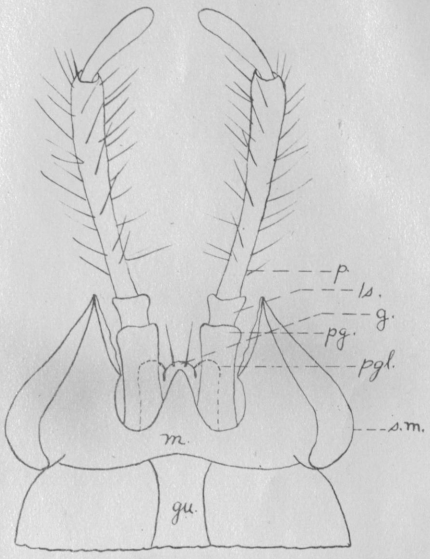

Fig. 3

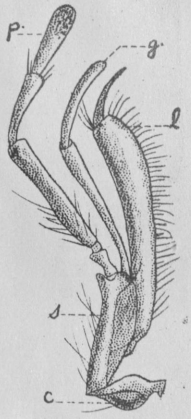

Fig. 4

Fig. 2

Fig. 5

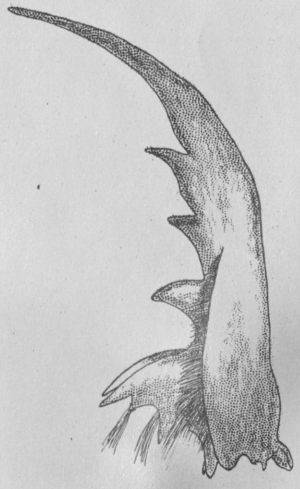

Fig. 6

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C (Cont.)

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